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Chapter 1

Introductory Chapter: Controversies in the Diagnostics and Management of Acute Appendicitis

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1. Introduction

Acute appendicitis is one of the most common diseases in urgent surgery. Despite this, it is not always easy to diagnose it, even for experienced surgeons. Acute appendicitis should be suspected in any patient with abdominal pain, and its correct diagnosis in many cases depends on the completeness of anamnestic data.

There are no other diseases that have such a variety of symptoms as acute appendicitis. At the same time, if gangrene develops, it may be asymptomatic until complications occur. And who among the surgeons have not ever observed the typical classic symptom complex and at the same time the absence of visual morphological changes in the appendix, after removal of which the patient felt better in the next few hours after the operation? In short, atypical acute appendicitis is more frequent than its classical manifestations.

2. Natural history and clinical assessment

As a rule, the main sign of acute appendicitis is abdominal pain, which makes a patient visit the doctor. It should be emphasized that the pain does not always occur in the right iliac fossa being the most typical position of the appendix. It may be in the epigastric region or migrate throughout the abdomen without any specific localization. In the initial period, pain is not intense, dull, and only occasionally may be cramping. After 2–3 h from the onset of the disease, they gradually increase and move to the right iliac region where the appendix is localized. This pain displacement is characteristic of acute appendicitis onset and is known as Kocher-Volkovich sign. This sign results from the initial pain signals being transferred through the midgut visceral innervation. When the parietal peritoneum starts being involved in the inflammatory process, the pain acquires more certain localization.

Often patients mistakenly associate the presence of abdominal pain with an unhealthy diet or believe that they have got poisoned, especially since the disease is accompanied by loss of appetite, nausea, and one- or two-time reflexive vomiting from the very beginning. Sometimes patients try to induce vomiting artificially or pump the stomach. Murphy, in 1904, first described vomiting and migration of colicky central abdominal pain to the right iliac fossa.

Cope described constipation in patients and their expectations of pain relief after defecation, which does not happen. Urination problems are rare.

A simple visual examination in the first few hours shows the doctor that the patient's condition is not worsened much. He is comparatively calm, moves actively, and sometimes holds on to his right side. Pulse rate typically increases and does not correspond to body temperature, which often remains normal and rises as destructive changes develop in the appendix.

Further examination is supposed to reveal three signs that characterize acute appendicitis: tenderness, muscular contraction, and skin hyperesthesia (Dieulafoy triad). Abdominal tenderness is the most typical sign of acute appendicitis. Visually, the movements of the right iliac region moderately lag during breathing. An attempt to take a deep breath, draw in a stomach, or make a cough causes an intensification of pain.

Palpation of the abdomen should be started from the left side, away from the pain area. Caressing counter-clockwise movements should gradually approach the right iliac region, where the patient may suddenly feel a sharp and intolerable pain. In some cases, its epicenter is McBurney's point, which was described by the author as follows: "…exactly between an inch and half and two inches from the anterior spinous process of the ileum on a straight line drawn from that process to the umbilicus" [1]. This point was assumed to match with the location of the inflamed appendix irritating the abdominal peritoneum over the T11 and T12 dermatome segment. Opposed to McBurney's original description, most textbooks mistakenly define the point as being one-third of the line from the anterior superior iliac spine to the umbilicus. Meanwhile, Lanz believed that "the McBurney's point has nothing to do with the origin of the vermiform appendix" and suggested its own localization that is on the line between the two anterosuperior iliac spines one-third of the distance from the right spine [2].

In general, the projection of pain need not necessarily correspond to the Lanz or McBurney's point. Occasionally, pain is noted on the middle line under the umbilicus or above the pubic region. Less often it is found anteriorly or posteriorly in the right- or left hypochondrium. In the absence of pain in the surveyed areas, it is advised to turn a patient on the left side and palpate over the iliac crest and along its entire length. If a negative result is obtained, rectal examination should be started. Pain in the Douglas pouch is an excellent sign. It often combines with pain in the right iliac region but is often found singly.

Abdominal wall muscle contraction or defense (muscular protection) is the most important of the signs revealed on careful examination. According to Mondor, there is no other sign which allowed doctors to save more lives than this one. When palpating an abdomen, which is not swollen and rigid but does not participate in respiratory movements, it is necessary to attempt to find the reaction of the abdominal wall in the form of muscular contraction. In acute appendicitis, it is usually localized in the right iliac region. Skin hypersthesia appears in most cases of local or diffuse peritonitis [3].

In addition, there are many symptoms and signs that can be associated with appendicitis, depending on the location of the inflamed vermiform appendix, for example: Dunphy's sign (coughing intensifies pain in right lower quadrant), obturator sign (hip flexion and internal rotation increases pain), psoas sign (right hip passive extension increases pain in a patient lying on the left side), Rovsing's sign (palpation in the left lower quadrant intensifies pain in the right lower quadrant), etc. At the same time, most of them are not specific and their importance increases significantly when they are evaluated together with laboratory signs [4].

3. Laboratory values

Changes in laboratory parameters in acute appendicitis include leukocytosis with left shift and increased inflammatory markers such as C-reactive protein and erythrocyte sedimentation rate. As with the clinical symptoms and signs, each particular laboratory value hardly indicates the presence of acute appendicitis. However, combinations of clinical and laboratory data or aggregate of various laboratory values are more reliable. For example, it was determined that high rates of laboratory inflammatory markers such as white blood cell and granulocyte counts and C-reactive protein level were comparatively strong predictors of perforated appendicitis, whereas low values testified to its absence [5].

4. Scoring systems

There are several clinical scoring systems that are used to diagnose acute appendicitis. In 1986, Alfredo Alvarado developed his score, also called MANTRELS based on the mnemonic for remembering the combination of eight signs and symptoms: migration (1), anorexia-acetone (1), nausea-vomiting (1), tenderness in right lower quadrant (2), rebound pain (1), elevation of temperature (1), leukocytosis (2), shift to the left (1). Each indicator is assigned 1–2 points, which are then summed. If the sum of points equals numbers from 0 to 4, acute appendicitis is unlikely. The score of 5 or 6 means that acute appendicitis should be suspected and observation is necessary. The score of 7 and 8 signifies that the diagnosis is probable. Acute appendicitis is very likely if the score is 9 or 10 [6]. Currently, there have been developed the modified versions of the Alvarado scale, such as the Pediatric Appendicitis Score, described in 2002 by Samuel [7] and other scores such as the Eskelinen, Ohhmann, RIPASA scores [8], etc. Generally, these clinical scoring systems are more informative than specific symptoms or signs alone. Still, they are not capable of predicting appendicitis with sufficient probability and therefore should not be used alone to diagnose it. They have been applied to define the necessity for radiological tests or as a guide for planning clinical management.

5. Radiologic imaging

Radiological imaging is used more and more to evaluate abdominal pain and diagnose acute appendicitis. On one hand, imaging may be useful in the examination of patients with abdominal pain for establishing or excluding other diagnoses or for averting unnecessary surgery. On the other hand, imaging could possibly delay operation, and in the case of computed tomography (CT), radiologic imaging exposes patients to the risks of ionizing radiation. Abdominal ultrasound (US) is less and less used to diagnose acute appendicitis. It was designated that US sensitivity and specificity in this disease do not exceed those of physical examination or approved clinical scores such as the Alvarado score [9]. The noninvasive gold standard for acute appendicitis remains CT with contrast medium. It was proved that preoperative CT reduced the number of negative appendectomies but increased waiting time for surgery, although perforation rate was not elevated [10]. Magnetic resonance imaging (MRI) is a promising technique because of its high diagnostic accuracy and avoidance of ionizing radiation and intravenous contrast medium [11].

6. Management

Appendectomy is one of the most common surgical procedures performed worldwide. Since the late 1880s, open appendectomy has been accepted as the standard for the treatment of acute appendicitis and has saved many lives since then. In Europe, it was promoted by the thesis of Charles Krafft "Essay on the need for surgical treatment of perityphlitis and purulent perforated appendicitis" (1888), while in America there were the works of Charles McBurney, in particular, "Experience with early operative interference in cases of disease of the vermiform appendix" (1889) [12].

Treatment of uncomplicated acute appendicitis without surgery is principally unstudied, although it often resolves spontaneously or with antibiotic therapy. Few studies state that it has the outcomes comparable to those of appendectomy [13].

The widespread use of CT for the diagnosis of appendicitis led to interesting observations regarding the possibility of spontaneously resolved acute appendicitis. It was shown that the inclusion of the CT result in the Alvarado score increases the frequency of appendectomy. When classified as having a low likelihood of appendicitis (Alvarado score ≤ 4), patients who underwent a CT scan had an appendectomy rate of 48%. In contrast, those with an Alvarado score ≤ 4 who did not undergo a CT scan had an appendectomy rate of only 12% [14].

In another study, diagnostic laparoscopy was used instead of CT scan in the management of patients with nonspecific abdominal pain. Patients were randomized to either (1) diagnostic laparoscopy or (2) nonoperative management (with operative intervention if peritonitis developed). The appendectomy rate was 39% for those randomized to diagnostic laparoscopy and 13% for those managed nonoperatively [15].

In a number of studies, the incidence of acute uncomplicated appendicitis correlated strongly to the incidence of normal appendix removal and inversely correlated to diagnostic accuracy. Due to this, the authors reasoned that the observed incidence of uncomplicated appendicitis was influenced by the willingness to perform appendectomy in cases of presumed appendicitis. A high rate of appendectomy in such situations increases the proportion of confirmed cases probably by adding instances of self-limited inflammation that would escape detection in other circumstances [16]. This indirect evidence indicates that uncomplicated acute appendicitis can initially be treated without resorting to surgery. The safety of the initial nonsurgical treatment of uncomplicated appendicitis was further confirmed, and it was shown that successful appendectomy can be avoided in almost all patients for the first 24 h with antibiotic therapy [17].

A large, population-based study using the American College of Surgeons National Surgical Quality Improvement Program database supports this semi-elective strategy, suggesting that appendectomy may be delayed up to 24–48 h without a significant increase in adverse outcome. In that study, there was no difference in the complication rate for those undergoing appendectomy within 1 day of admission. However, complication rate doubled if waiting time for surgery was delayed more than 48 h [18]. Contrary to the studies supporting a safe delay of appendectomy, there have been investigations demonstrating negative outcomes of even 6–12 h delays in surgery [19]. A recent study from the UK found no increased rate of complicated appendicitis when appendectomy was performed within 48 h [20].

7. Acute appendicitis in children

Acute appendicitis is one of the most common surgical diseases in children. It occurs in all age groups, but rarely in infants. The associated lethality is 0.1–1% with prevalence in young children. Death in infants and neonates happens because of: (1) the failure to identify the disease because of its clinical presentation, which is similar to other common conditions in this age group, and (2) the inability of a younger patient to tell about abdominal pain or the absence of systemic symptoms, such as fever. At the time of the diagnosis, the percentage of perforated appendicitis has been up to 30% [21]. The percentage of perforation has been stated as high as 80–100% for children younger than 3 years, compared with 10–20% in 10–17-year-old children [22].

In general, the strategy of diagnosis and treatment of acute appendicitis in children does not differ much from adults. Problems in the treatment of acute appendicitis are mostly the same in adults and children. Important concerns about the diagnosis, surgical technique, and antibiotic therapy remain uncertain for all patients. There are specific considerations for a pediatric appendectomy that remain questionable. They include the growing use of single-incision or single-port laparoscopic appendectomy and the primary nonoperative management of acute appendicitis with or without following appendectomy [23].

8. Conclusions

Acute appendicitis, being one of the most common diseases in emergency abdominal surgery, is a problem that still creates diagnostic difficulties. Although clinical studies alone cannot be sufficient to diagnose appendicitis, the importance of careful anamnesis and physical examination should not be underestimated. If extra tests are necessary, their risks and opportunities should be considered along with the possibility that such tests will change the management. Progress in imaging and computer decision support hold promise for the future, but additional study is needed to guarantee the accuracy, efficiency, and cost-effectiveness of novel diagnostic approaches for acute appendicitis.

The available data concerning nonoperative management of acute appendicitis is discrepant. Pathologic confirmation of appendicitis is one of the difficulties in performing a well-planned randomized clinical trial of nonoperative versus operative therapy for acute appendicitis. Successful antibiotic therapy for "suspected" appendicitis may cause doubts about the diagnosis. On the other hand, there are patients who undergo a negative appendectomy and surgical risks, which is a valid concern.

In spite of the fact that acute appendicitis is widespread, optimal diagnostics and management of it remain uncertain. This problem may be solved by conducting large multicenter randomized trials.

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